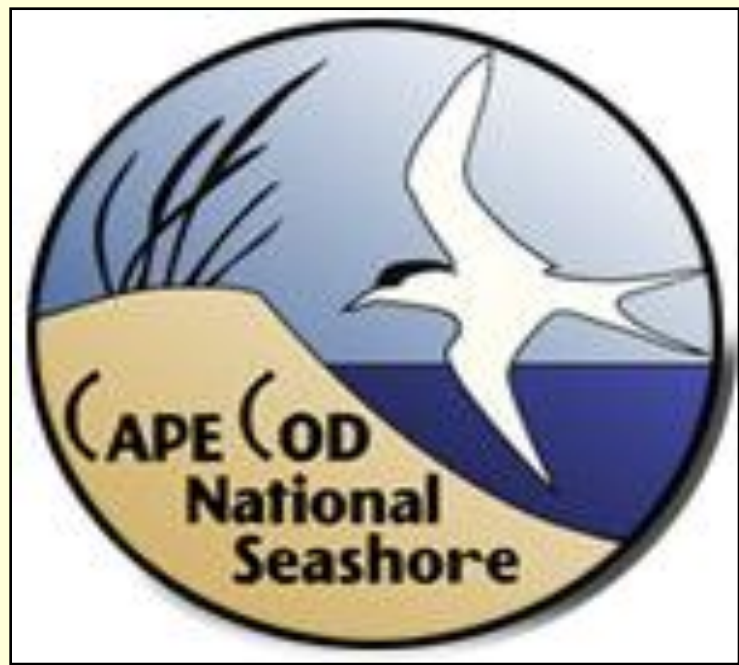# IMPROVING CALLING SURVEYS FOR DETECTING FOWLER'S TOAD, *BUFO FOWLERI*, IN SOUTHERN NEW ENGLAND, USA

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INTRODUCTION

• The goal of this research was to evaluate the existing Cape Cod National Seashore (CACO) amphibian monitoring program's ability to detect Fowler's toad, *Bufo fowleri*, and to improve *B. fowleri* monitoring throughout southern New England.

METHODS

• We sampled 67 wetlands at CACO with weekly calling anuran surveys from 2003-2005 between 2 April and 24 July.

• To determine if 3-minute surveys were adequate for detecting *B. fowleri* calls, we used an accumulation curve to plot time to first detection.

• We used a Pearson Chi-Square statistic to identify the optimum 14-day survey window for *B. fowleri*.

• To identify environmental conditions associated with calling we used a series of hypothesis tests, descriptive statistics, and a classification tree.

RESULTS

Survey Duration

• Moderate and full choruses (i.e., calling index {CI} values 2 and 3, respectively) were always detected within the first minute of a survey.

• When non-overlapping calls were detected (i.e. CI value 1), 76% of detections occurred in the first survey minute and 96% occurred by the end of the third minute (fig. 1).
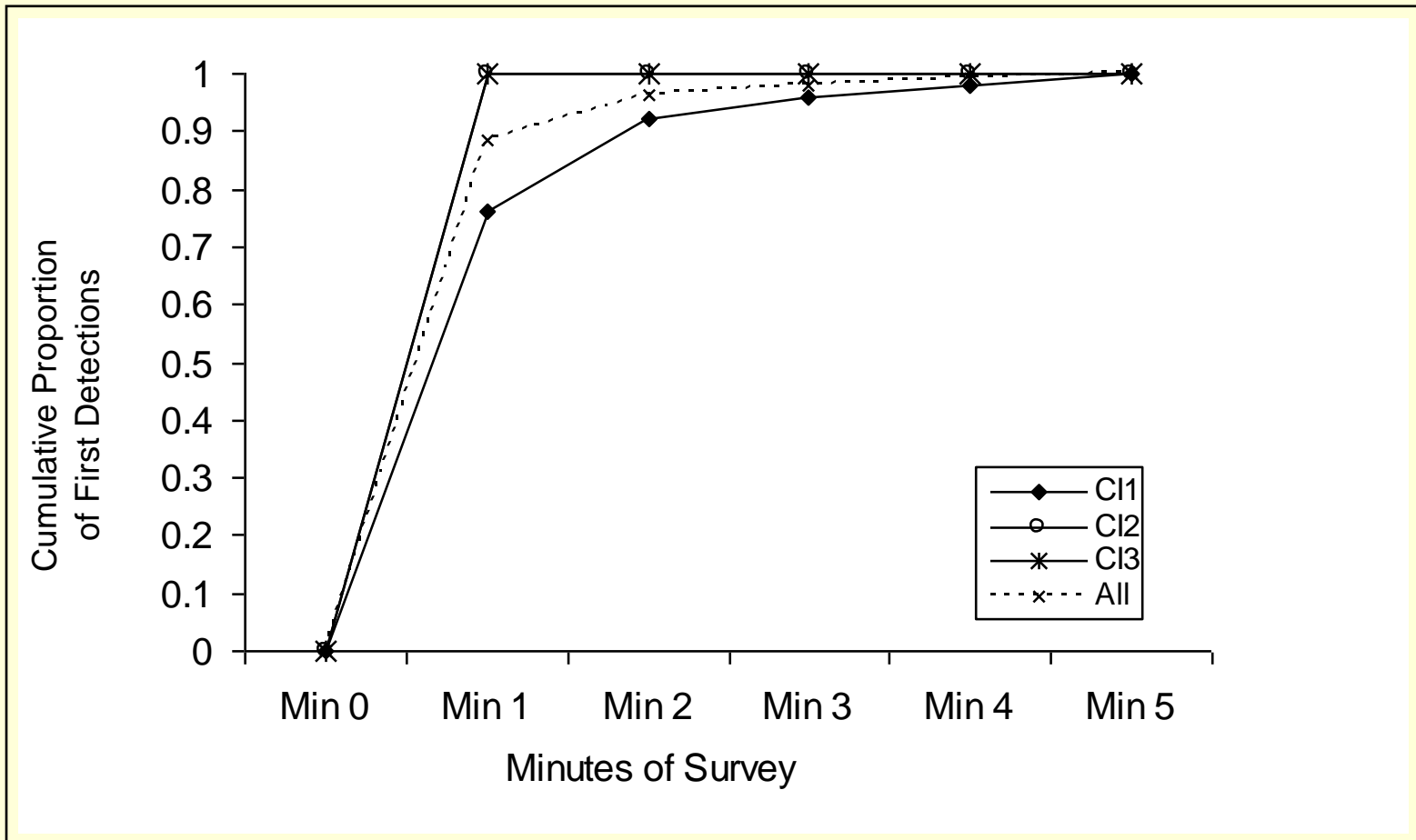

Figure 1. Time to first detection of *B. fowleri* during 5-min calling anuran surveys. Each minute interval shows the cumulative proportion of first detections as of that interval.

Diel, seasonal and interannual calling chronology

• Mean time (minutes after sunset) of sampling events with detections (109.6±3.9) was significantly earlier than non-detections (124.7±3.3; $T_{732,734}$ = 2.914, *P*= 0.004). Mean time of peak calling (full chorus) occurred 103.0±8.7 minutes after sunset.

• When analyzed by year, there was some interannual variation, but all peaks occurred in June. The earliest and latest documented vocalizations were 22 April and 17 July, respectively. The earliest and latest full choruses were 1 May and 10 July, respectively.

• Interannual variation in *B. fowleri* calling chronology was apparent but when we pooled all years, truncated survey periods, and analyzed data on a 14-day basis (fig. 2), early June (31 May – 13 June) contained the largest proportion (30.6%) of surveys with detections (χ^2=19.634, 4 df, *P* = 0.001).
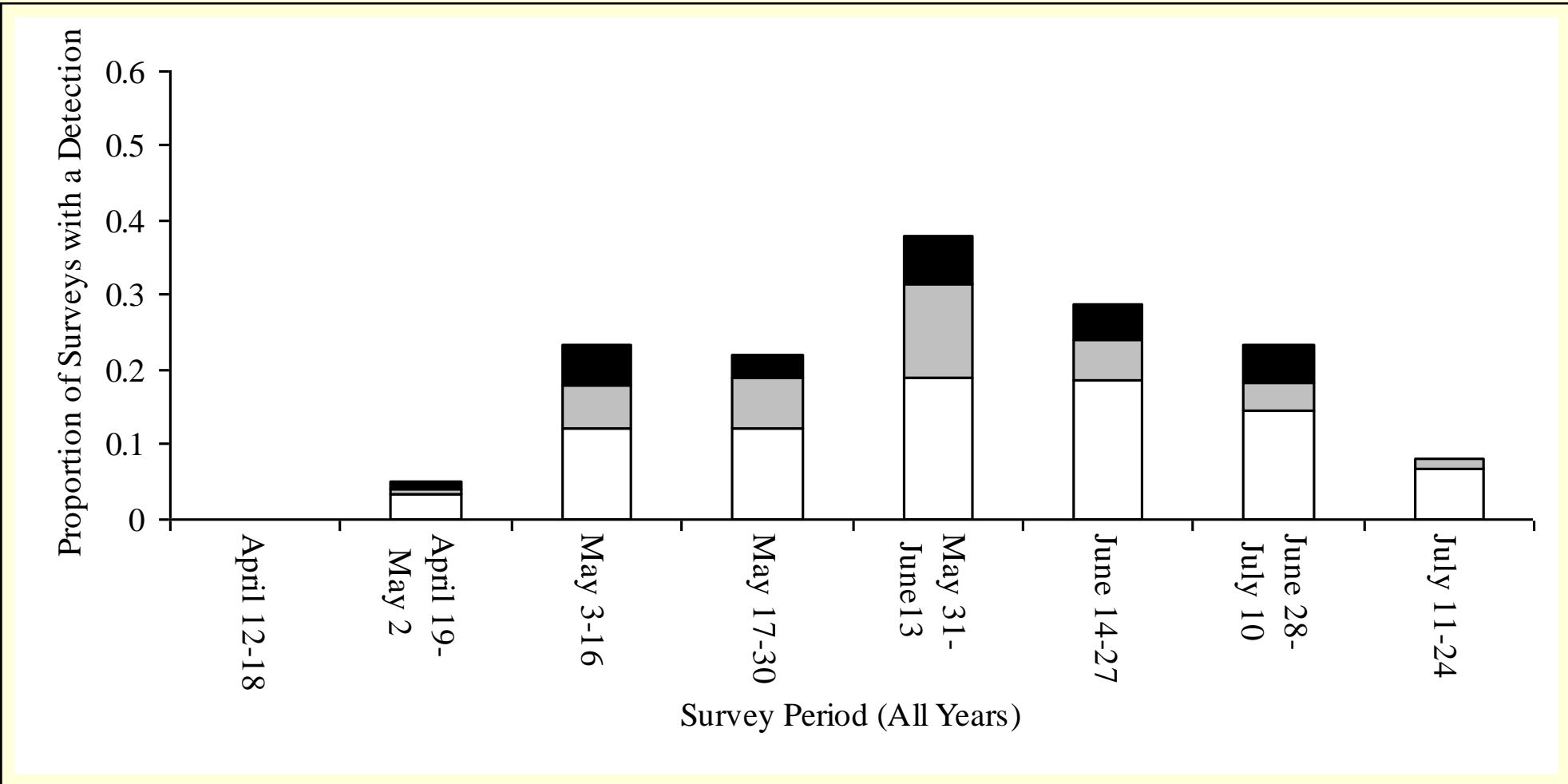

Figure 2. Seasonal calling chronology of *B. fowleri* at CACO. Data are expressed as proportion of surveys with detections within 14-day survey intervals. Colored bars represent detections of a particular CI value. Black bars indicate CI value = 3, grey bars indicate CI value = 2 and white bars = CI values of 1.

Environmental correlates of calling

• We found significantly more detections when cloud cover was <50% (χ^2= 19.125, 2 df, *P* = 0.000) and when wind speed was from 0-7mph (χ^2= 6.421, 2 df, *P* = 0.040). There was no chorusing during rain events or when winds were ≥ 19 mph.

• There were significant differences in surface water temperature ($F_{3,734}$ = 24.925, *P* = 0.000) and air temperature ($F_{3,734}$ = 20.0, *P* = 0.000) associated with calling. Mean and median air and water temperatures increased with calling index value (Table 1).

Variable	Bufo CI	Descriptives		SE
		Median	Mean	
Air Temp	0	13.0 1	13.0	0.2
	1	15.3 2	15.2	0.4
	2	16.0 2	15.5	0.5
	3	18.2 2	16.7	0.6
Water Temp	0	16.0 1	16.1	0.2
	1	18.4 2	18.2	0.3
	2	18.5 2	18.7	0.4
	3	20.0 2	19.7	0.5

Table 1. Median and mean air and water temperatures grouped by calling index values. SE = standard error. Means with same subscript belong to the same homogeneous group.

• Classification tree analysis yielded a highly significant (*P* < 0.01) 6 terminal node tree (fig. 3) where surface water temperature, Julian date, and air temperature were selected as splitting variables.
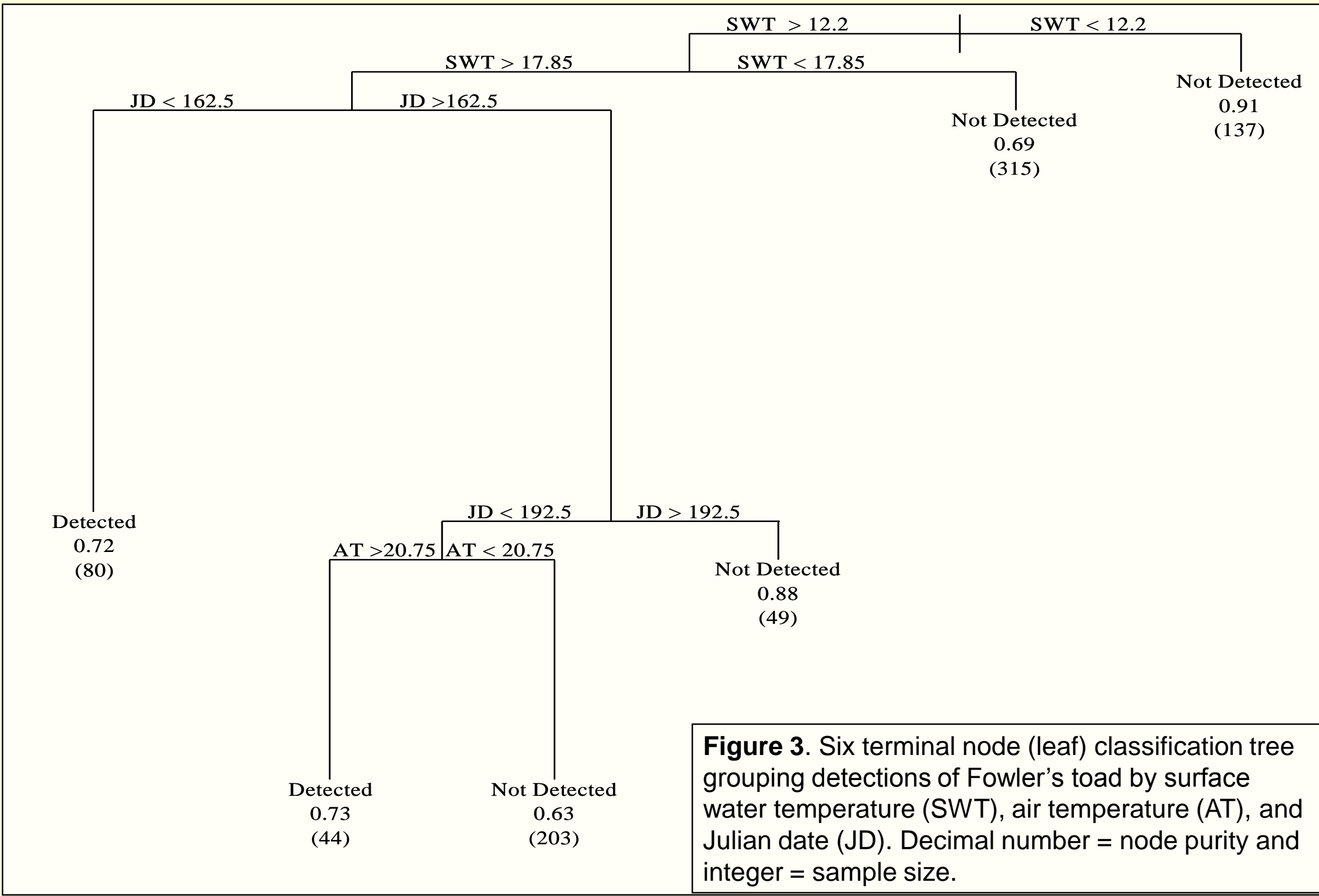

Figure 3. Six terminal node (leaf) classification tree grouping detections of Fowler's toad by surface water temperature (SWT), air temperature (AT), and Julian date (JD). Decimal number = node purity and integer = sample size.

CONCLUSIONS

• To monitor *B. fowleri* in southern New England, we recommend 3-min calling surveys within two hours of sunset on calm night in June, when surface water temperature exceeds 17.85˚C